# DIELECTRIC AND NONLINEAR OPTICAL PROPERTIES OF PRECURSOR IN PHOTO CROSSLINKABLE POLYMERS

Kang I. Seo*, Carl E. Bonner, Shahin Maaref, and Sam Sun
Center for Photonic Materials Research
Norfolk State University
Norfolk, Virginia 23504
* E-mail address: kseo@jlab.org

The nonlinear optical (NLO) and dielectric properties of novel polymers have found increasing use in devices such as optical fibers and waveguide, optical sensors, and thin films for integrated optical applications. It is important to understand the dielectric, optical and mechanical response of polymeric materials to optimize their usage in these applications.

The search for new functional polymers that can be used efficiently in optoelectronic devices require facile and cost effective process. One promising method is the synthesis of unsaturated polyester containing a NLO chromophore derived from fumaryl chloride that is shown in Fig. 1 (a). The fumaryl type precursor has an advantage over maleate monomers. New monomer combines faster formation of the polymer with an easier purification process. Another significant advantage of this method is that it offers the ability to fabricate integrated optical device through photochemical cross-linking.

The practical applications of second-order NLO polymeric materials also require high NLO activity and thermal stability. Cross-linking method is one approach to achieve thermodynamically stable chromophore ordering in NLO polymers. This method has been used to prevent the relaxation of aligned chromophore caused by thermal motion of polymer chain. We report here on a variety of crosslinking agents shown in Fig. 1 (b) for stabilizing poled chromophores in the polymer.

A spectrophotometer is used to measure the transmission (T) and absorption (A) of a polymer film samples, with thickness of 1-6 μm. The samples treated here is a polymer film on a transparent ITO substrate deposited by spin coating. In this work, we have measured by simple methods the optical constants from the transmittance spectra [Fig. 2].

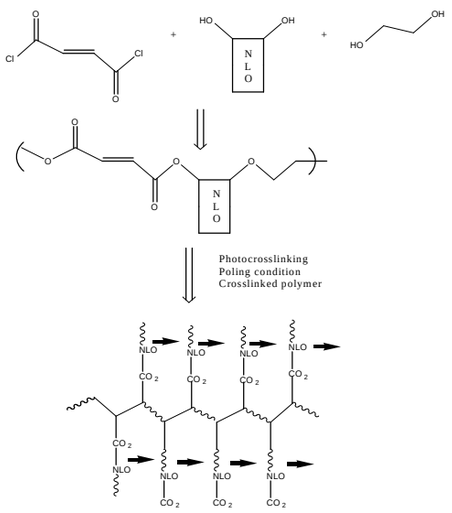


Fig. 1 (a). Synthetic protocol for fumaryl type polymerization.

For calculation of the absorption coefficient (α) from the transmission data we can obtain the fundamental absorption edge, which is one of the most important parameters for optoelectronic device design. Spectroscopic ellipsometry (SE) has been also used to investigate thickness and dielectric function of the polymer samples [Fig. 3].

We will discuss also the relationship between optical properties and microstructure dependence on the molar fraction of polymers.

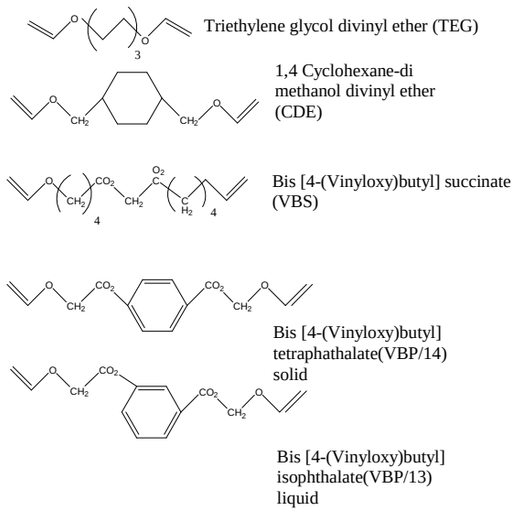


Fig. 1 (b). Various types of crosslinker agents.

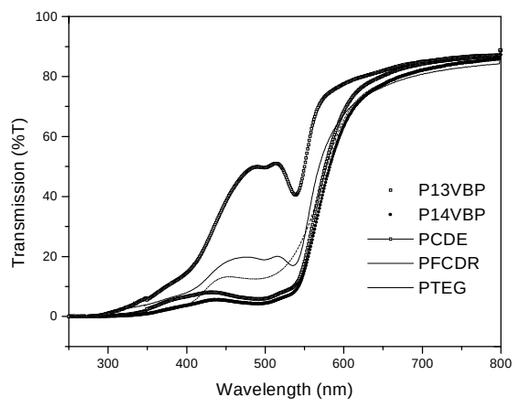


Fig. 2. Transmission vs. wavelength spectra of polymer samples with crosslinker agents.

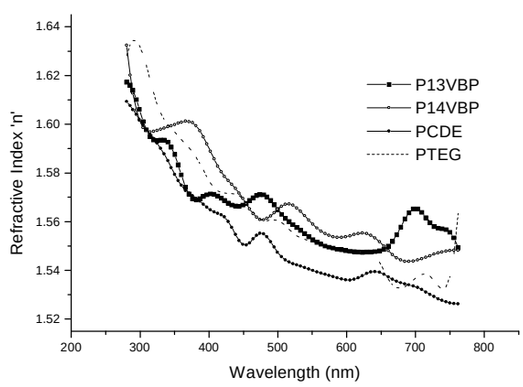


Fig. 3. Refractive index, n(λ), of polymer samples.